CONTRIBUTION OF LIFE ORGBALT CALCULATED EFS FOR THE ESTIMATION OF GHG EMISSIONS FROM DRAINED NUTRIENT-RICH ORGANIC SOIL

Greenhouse gas (GHG) emissions from drained Histosols contribute more than 25% of emissions from the Land Use, Land Use Change and Forestry (LULUCF) sector (Vigiricas et al., 2024). Share of organic soil emissions in the project countries GHG emissions profiles varies from 5% of the net GHG emissions including LULUCF in Germany to 59% in Latvia and 72% in Finland. One of the main activities of the LIFE OrgBalt project – performing measurements of GHG emissions in managed organic soils which allows to develop and publish regional GHG emission factors. Developed regional GHG emission factors were applied in the calculation tool, developed to project GHG emissions from different land uses, management practices and different climatic conditions applied.

Calculation tool also offers non-spatial modeling of peatland soil forest stand development and GHG emissions from soils as well as savings of GHG emissions due to different management applied or land-use change for certain scenarios available and GHG emission savings if biomass subsitution is taken into account (in case of forest land GHG projections).

Methodology included in the calculation tool

Main input data to the spreadsheet tool, common for all countries:	**Country specific input data (if available):**
• Assortment structure for HWP with production losses • Production of assortments during different management actions (thinning, regenerating) • Biomass equations with coefficients • Polynomial equations for carbon inputs from woody litter, non-woody litter, carbon stock in non-woody plants, dead wood, sawnwood, platewood, paper and paperboard	• Forest stand data – age, height, diameter, basal area, N of living, harvested and dead trees • Temperature projections (correlation with CO_2) • Carbon stock in litter, carbon stock in agricultural biomass, soil carbon input ir agricultural land (due to decay of biomass) • EFs for both drained and not drained (wet) conditions: CH_4, N_2O, CO (heterotrophic respiration) + dissolved organic carbon (DOC)

All parameters in the model are selectable for 5 countries or regions, including general assumptions for boreal and temperate climate region. The most of the parameters in the default version of the model are the same for all regions, and can be updated during the adaptation of the model to different conditions.

Coefficients for calculation of woody biomass is provided for above-ground biomass, stem biomass, branch biomass and below-ground biomass for all species listed in a sheet [3] of a tool, except willows, for which biomass is calculated separately using cone formula; coefficients can be easily updated to better represent particular country, when available. The default factors are based on a study results presented by Liepiņš et al. (2017, 2021). Following formula (No. 1) is used for calculation of all types of woody biomass.

$$\text{Biomass (kg)} = k \times \exp\left(a + b \times \left(\frac{D}{D+m}\right) + c \times H + d \times \ln(H) + e \times \ln(D)\right) \quad (1)$$

Carbon input with woody litter is calculated using species specific polynomial equation. Upper limit for the carbon input is set according to the basal area threshold values, according to the results of Bārdule et al. (2021):

(tonnes C ha^{-1} yr^{-1}) = × a + × b + × c + G × d + e(2)

G is basal area expressed as m2 ha^{-1}.

GHG emission and removal projection results for 2050

GHG projection tool was designed to provide GHG estimations for various (13) different climate change mitigation measures, as developed during the LIFE OrgBalt project (Table 2).

Table 1. Climate change mitigation measures included in GHG projection tool

	Brief description of CCM included
1	LVC301 Transformation of arable land with drained organic soil into grassland
2	LVC302 Afforestation of grassland with drained organic soil
3	LVC303 Forest paludiculture - afforestation with black alder and birch
4	LVC304 Use of papilionaceous plants in plant rotation in arable land with drained organic soil
5	LVC305 Controlled drainage in grassland with drained organic soil
6	LVC306 Agro-forestry – plantation of woody plants in arable land with drained organic soil
7	LVC307 Use of wood ash in a spruce stand with improved peat soil after maintenance felling
8	LVC308 Selective felling of fir trees with improved organic soil
9	LVC309 Regeneration with black alder in a forest stand with naturally moist peat soil using deep furrow netting
10	LVC310 Planting of fast-growing tree species in the protection zone of drainage systems
11	LVC311 Black alder plantation in an area with naturally moist organic soil adjacent to the forest coastal protection belt
12	LVC312 Paludiculture - regeneration of spruce stands with naturally moist organic soil using deep furrow nets
13	LVC313 Strip felling in a pine plantation with improved organic soil

Comparison of the business-as-usual scenario and mitigation measures is provided as a cumulative effect in 50 years, including or excluding biofuel substitution effect. It is evident, that the highest GHG reduction potential (or even net carbon accumulation) is projected for the measures including carbon accumulation in woody biomass: Agro-forestry (LVC306) or planting of fast-growing tree species in the protective zones (LVC310). Afforestation of drained grasslands (LVC302) or forest paludiculture (afforestation with black alder and birch) could also significantly reduce GHG emissions from drainage of organic soils. While the trend of GHG emission reduction and carbon accumulation in Latvia and Lithuania looks similar across the mitigation measures applied, the scale for each measure is different due to national tree growth dynamics and different climate projections applied.

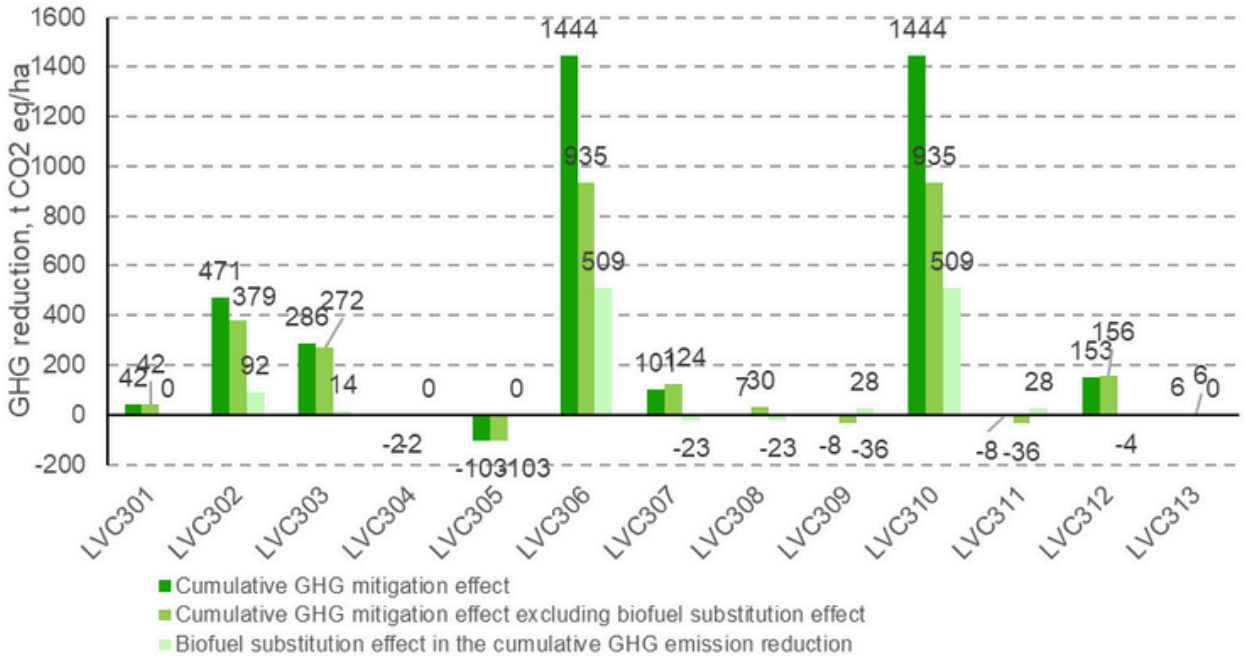

Figure 2. Comparison of the effect of different climate change mitigation measures applied for Lithuanian conditions, tonnes CO^2 eq ha^{-1}

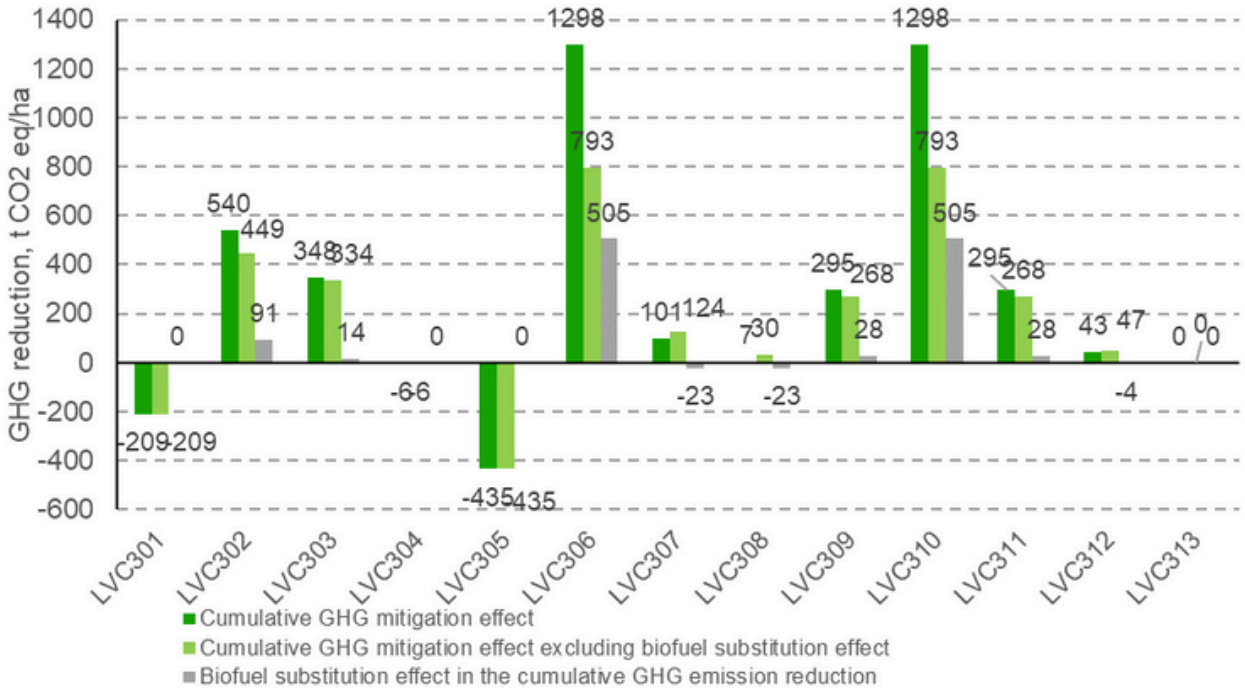

Figure 3. Comparison of the effect of different climate change mitigation measures applied for Latvian conditions, tonnes CO^2 eq ha^{-1}

Several different sets of emission factors (for estimation of GHG emissions from drained organic soils) were applied to estimate their impact to total LULUCF GHG balance in Lithuania during the LIFE OrgBalt project. The results of the exercise show that EF's proposed from LIFE OrgBalt project results would result in smaller total LULUCF GHG removals in Lithuania compared to the default 2006 IPCC Guidelines EF's applied, but larger compared to the default EF's from 2013 IPCC Wetlands Supplement applied.

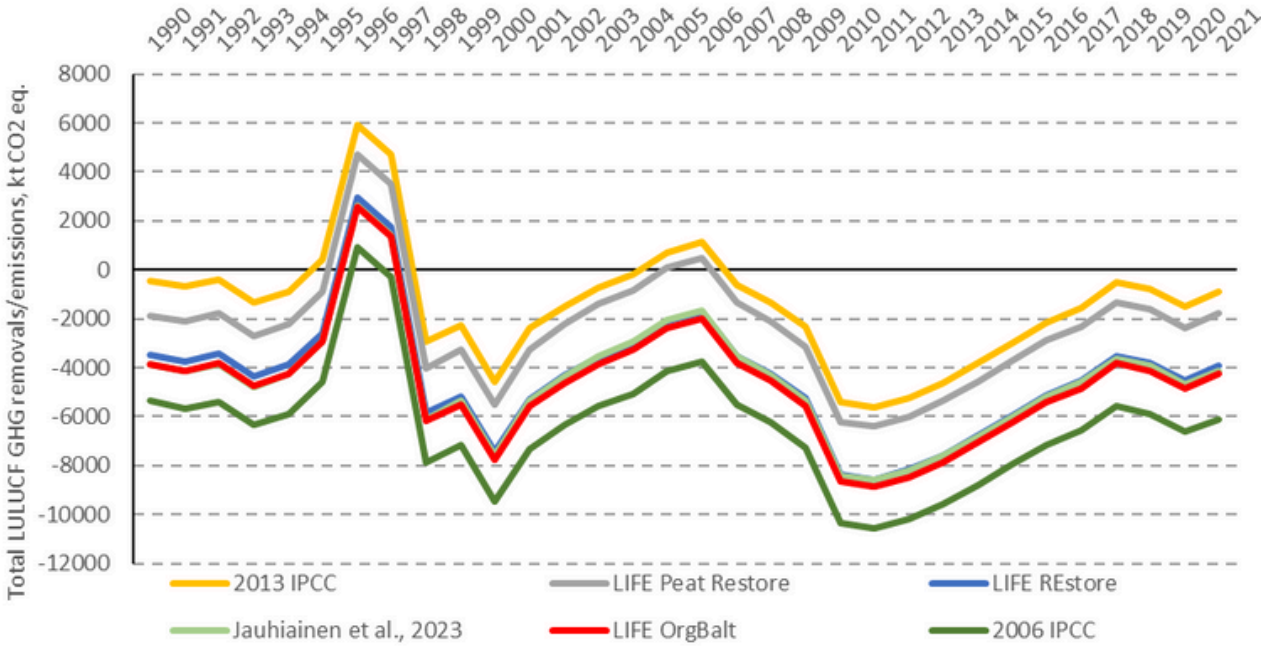

Figure 4. Total LULUCF GHG removals/emissions with different EFs for estimation of GHG emissions from drained forest land, cropland and grassland applied, kt CO^2 eq (LIFE Restore – Lazdiņš A., Lupiķis A., 2019; LIFE Peat Restore – Jarašius et al., 2022).

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